

and about 6 miles long; no casualties; moved northeast; destruction confined principally to timber.

25th.—A severe wind and rain storm occurred at Santa Rosa, Cal., on this date. Dwelling houses and barns were moved from their foundations, and trees were prostrated.

28th.—The general meteorological conditions on the 28th were not greatly different from those of May 15, last. The area of low pressure on the morning map was to the north-westward. Snow was falling in the Rocky Mountain Region (on both dates), and warm southeast winds prevailed throughout the Mississippi Valley. Severe storms, and in some localities minor tornadoes, occurred in Texas, Oklahoma, and Indian Territory. The region of tornadic activity in Texas was almost identical with that traversed by the Sherman tornado (May 15, 1896), but the funnel-shaped clouds were narrow, and the rotary winds were not of unusual violence. Two funnel clouds were observed at Farmington, three at Howe, and one three miles east of Sherman. The funnel clouds observed at Howe were high in the air, and no destruction was wrought by them in that vicinity. The tornado path was from 30 to 200 yards wide, and its probable length 8 or 10 miles. Six persons were injured near Howe and Farmington. The property loss was not great, probably \$2,000 or \$3,000 in all.

Alderson, Ind. T., was visited by a minor tornado at 3 p. m., central time, of the same date. Two persons injured; property loss about \$2,500; path of destruction, 150 feet wide and one-half mile long; general progressive movement toward northeast. Press reports of tornadoes in Lincoln, Logan, and Payne counties, Okla., have not yet been verified.

Wewoka, Ind. T., was also visited by a small tornado about 10.15 p. m., central time, of the same date. Three persons were injured. Two residences, one church, one stone store building, and one warehouse were destroyed. The path of great destruction was about one-fourth mile wide and 4 miles long.

29th.—Tornadoes occurred on this date in Arkansas, Louisiana, and Mississippi. The most destructive storm passed through Tensas Parish, La., at about 11.30 a. m., probably central time. Two persons were killed and thirteen wounded; the property loss was about \$15,000. The path of the storm was about 200 yards wide; length unknown; movement toward northeast. About 10 a. m., central time, a destructive storm passed through Jefferson County, Ark., striking the edge of the small hamlet of Tucker. Seven dwelling houses were totally destroyed and three people were injured; the path was about 50 yards wide, increasing at some points to one-half mile; length unknown; storm moved northeast.

The western edge of Coffeyville, Miss., was struck by a tornado at 2 p. m., central time. One person injured; property loss about \$1,750. Width of path of great destruction, 150 feet; length, 750 feet; moved northeast.

The station Delay, in the eastern part of Lafayette County, Miss., was visited by a tornado at 3 p. m., probably central time, of the same date. No casualties; property loss, \$2,500. Storm moved northeast.

The following account of the waterspout-tornado that visited New Orleans, La., on this date is contributed by Mr. Robert E. Kerkam, Local Forecast Official, Weather Bureau, New Orleans, La.:

The storm commenced at 4 p. m., local time, by the coming together of two large, black clouds, on the Mississippi River, almost opposite Milan street, forming a waterspout that moved down the river, crossing toward the land and first assuming tornadic form at the head of General Taylor street. A mild thunderstorm was in progress over the city at the time, but there was little lightning or thunder, and the conditions did not appear to warrant anticipating tornadic development; the temperature and pressure showed no fluctuations at the station worthy of moment during the time the local storm was in progress.

The theory advanced is that common to waterspouts striking land in

this section. After leaving the water, the funnel lifted, only occasionally lowering to near the ground, at which times devastation occurred; but the cloud from which the funnel depended was heavy, and the cloud did not dissipate, or pass beyond the range of vision, after again reaching the river, until it had covered a mile or slightly more of river front.

The duration of the storm from the time it struck the head of General Taylor street until it passed Robin street in its northeastward movement to the river did not occupy more than a few minutes. Its course of movement was from southwest to northeast; funnel cloud black, surrounded by a misty, yellow covering about the lower part of the funnel; whirl from right to left, or contrary to the movements of the hands of a watch; rainfall only slight at 4 p. m., but heavy rain at 4.30 p. m., after the tornado had disappeared on the river; the noise accompanying the tornado's movement resembled a loud rumbling, similar to that of a railroad train; length of track, slightly exceeding a mile; width, variable; largest width of path of destruction about 200 feet; property destroyed estimated at from \$75,000 to \$100,000; no loss of life known; although it was reported that two negroes had been carried into the river, but ten persons were injured by falling or flying debris. No hail accompanied the storm, and but little lightning or thunder; after the storm passed there was a heavy fall of rain and a mild thunderstorm. The debris scattered along the path of the storm gave every indication of the usual whirling motion accompanying tornadoes; but as it consisted mostly of brick, slate roofs, etc., and as the funnel cloud frequently lifted and no material damage was done, therefore the path was not well defined, save in the last third of a mile where cotton presses and brick walls were demolished.

The local meteorological conditions at the observatory in the custom-house, distant some two miles from the tornado, were not materially affected; the temperature showed no fluctuations, there was only a very gradual rise in the pressure, as shown by the barograph, and the maximum velocity of the wind reached less than 20 miles per hour, with an extreme velocity of 24 miles per hour. The wind changed from south at 3.50 p. m., to southwest for two minutes, then to northwest for two minutes; to north for four minutes, to northwest for six minutes, with a sudden change to steady southeast from 4.05 to 4.40 p. m., local time.

Eye witnesses of the tornado differ as regards the appearance of surrounding clouds, two claiming that small funnel shapes were visible besides the general tornado funnel, and another stating that he watched the progress of the storm carefully, and noted only the one main funnel; the latter appears more credible, since the heavy clouds were at a low altitude, and a heavy rain apparent; it is possible that the masses of surrounding clouds confused the former witnesses.

Peculiar freaks of the wind were apparent along the path of the storm: At one point a bale of cotton was burst open and the cotton was strung and wound around the telegraph and other wires in the neighborhood, making them appear as if sleet and ice had frozen thereon; the telegraph poles and wires at this point were not disturbed, yet they were in the direct path of the storm. In one yard a tree in the center of the yard had been torn up by the roots, but no other vegetation or trees were injured, and no trace of damage could be found on the roofs of the buildings situated immediately next the yard.

The tornado, taken as a whole, was of a mild form and could not be classed with the storms that inflicted the great damage in Louisville or St. Louis, or others of like character.

Total known fatalities by tornado during the month, 4; by lightning, 5.

TEMPERATURE OF THE AIR.

[In degrees Fahrenheit.]

The mean temperature is given for each station in Table II, for voluntary observers. Both the mean temperatures and the departures from the normal are given in Table I for the regular stations of the Weather Bureau.

The monthly mean temperatures published in Table I, for the regular stations of the Weather Bureau, are the simple means of all the daily maxima and minima; for voluntary stations a variety of methods of computation is necessarily allowed, as shown by the notes appended to Table II.

The regular diurnal period in temperature is shown by the hourly means given in Table V for 29 stations selected out of 82 that maintain continuous thermograph records.

The distribution of the observed monthly mean temperature of the air over the United States and Canada is shown by the dotted isotherms on Chart IV; the lines are drawn over the Rocky Mountain Plateau region, although the temperatures have not been reduced to sea level, and the isotherms, therefore, relate to the average surface of the country occupied by

our observers; such isotherms are controlled largely by the local topography, and should be drawn and studied in connection with a contour map.

The *highest mean temperatures* were: Key West, 77.0; Jupiter, 75.5; Tampa, 72.0; Port Eads, 69.8; Jacksonville, 67.4. The lowest were: Havre, 3.8; Williston, 6.6; Bismarck, 7.2; Moorhead, 10.2. Among the Canadian stations the highest were: Bermuda, 68.2; Yarmouth, 41.2; Halifax, 39.5; Port Stanley, 39.0; Toronto, 38.9; Kingston, 38.8; Sydney, 37.6; Esquimaux, 36.4. The lowest were: Battleford, -3.4; Edmonton, -1.6; Banff, -0.8; Qu'Appelle, -0.4.

As compared with the normal for November the mean temperature for the current month was in excess throughout the Gulf and Atlantic States and the eastern portion of the Lake Region as, also, in the southern Plateau region and south Pacific Slope. It was deficient throughout the greater portion of the Dominion of Canada, the upper Lake Region, and westward to the Pacific. The line dividing the region of excess from that of deficiency passed nearly direct from southern Newfoundland to southern California. The greatest excesses were: Raleigh, 5.5; Tampa, 5.4; Philadelphia, 5.3; Harrisburg, 5.2; Port Eads and Hatteras, 5.0. The greatest deficiencies were: Edmonton, 28.6; Havre, 27.0; Medicine Hat, 26.0; Calgary, 24.6; Bismarck, 21.7; Williston, 21.3.

Considered by districts the mean temperatures of the current month show departures from the normal as given in Table I. The greatest positive departures were: Middle Atlantic, 4.2; South Atlantic, 4.5; Florida Peninsula, 3.8. The greatest negative departures were: North Dakota, 19.6; northern Slope, 13.2; Missouri Valley and northern Plateau, 5.9; north Pacific, 6.2.

The *years of highest and lowest mean temperatures* for November are shown in Table I of the REVIEW for November, 1894. The mean temperature for the current month was the highest on record at the following stations: Jupiter, 75.5; Tampa, 72.0; Port Eads, 69.8; Jacksonville, 67.4; Savannah, 63.4; Pensacola, 63.3; Charleston, 63.1; Hatteras, 61.2; Wilmington, 60.2; Augusta, 59.8; Columbia, S. C., 59.3; Norfolk and Cape Henry, 56.8; Charlotte, 55.6; Raleigh, 55.3; Knoxville, 52.6; Lynchburg, 52.2; Baltimore, 51.0; Washington, 50.6; Vineyard Haven, 50.5; Philadelphia, 50.4; Atlantic City, 50.2; Parkersburg, 48.7; Pittsburg, 48.6; Nantucket, 48.5; Block Island, 48.2; Harrisburg, 47.6; Woods Hole, 47.1; Narragansett Pier, 46.7; Boston, 46.5; New Haven, 46.3; Columbus, 45.2; Erie, 44.6; Cleveland and Sandusky, 44.2; Albany, 44.0; Rochester, 42.6; Northfield, 37.1. The mean temperature was the lowest on record at: Havre, 3.8; Williston, 6.6; Bismarck, 7.2; Moorhead, 10.2; Miles City, 12.7; Huron, 13.6; Pierre, 15.0; Helena, 18.4; Rapid City, 20.9; St. Paul, 21.8; Minneapolis, 22.6; Sioux City, 22.4; Green Bay, 29.4; Spokane and Baker City, 30.6; Walla Walla, 33.8; Concordia, 34.4; Port Angeles, 36.9; Portland, Oreg., 38.6; Tatoosh Island, 39.7; Fort Canby, 41.0; Astoria, 41.6.

This long list of stations for which the temperature during November was either the highest or lowest on record shows that we have to do with a month whose anomalies merit special attention, both to the student of climatology and to the investigator of the ultimate causes of meteorological phenomena.

The Editor has been favored by Mr. James Berry, Chief of the Climate and Crop Service, with the four weekly charts, VIII *a, b* and IX *a, b*, which show the departures from the 10-year normal for each station and for the average of each week. Mr. Berry states that it is doubtful whether the records of the Bureau will show another series like this. The deficiencies in the upper Missouri Valley are entirely unprecedented so far as our records show, and it may be assumed that it will not recur more than once in fifty years. At Havre,

Mont., the daily temperature averaged 40° below the normal for fourteen consecutive days. It will be noticed that in general the eastern half of our territory had unusual warmth, but the western half unusual cold. As these large features in the distribution of temperature must stand in some relation to the general circulation of the atmosphere, either as cause or effect, the reader is referred to a subsequent chapter in this REVIEW, by the Editor, "On the isobars at great altitudes." Meteorological reports from Europe show that there, also, the current November has been one of the coldest on record.

The *maximum and minimum temperatures* of the current month are given in Table I. The highest maxima were: 86, Key West, Shreveport, and Vicksburg (11th), and Yuma (17th); 85, Tampa (2d), Jacksonville and Montgomery (11th); 84, Jupiter (5th), New Orleans (11th), San Antonio (26th), and Los Angeles (12th). The lowest maxima were: 32, Moorhead (2d); 38, Williston (4th); 44, Duluth (16th); 45, Huron (16th); 48, Bismarck (16th); 50, St. Paul (16th). The highest minima were: 69, Key West (frequently); 64, Jupiter (9th); 53, Tampa (14th); 45, Jacksonville (30th); 43, San Diego (28th); 42, Yuma (28th) and Port Eads (30th). The lowest minima were: -33, Havre (20th); -31, Lander (27th); -26, Moorhead (29th) and Idaho Falls (28th); -25, Miles City (30th); -24, Williston (30th); -22, Helena (27th) and Bismarck (29th).

The *years of highest maximum and lowest minimum temperatures* are given in the four last columns of Table I of the current REVIEW. During the present month the maximum temperatures were the highest on record at: Vicksburg and Shreveport, 86; Montgomery, 85; Savannah, 83; Amarillo, 82; Pueblo, 81; Dubuque, 74; Portland, Me., and New Haven, 72. The minimum temperatures were the lowest on record at: Havre, -33; Lander, -31; Moorhead and Idaho Falls, -26; Miles City, -25; Helena, -22; Pueblo, -17; Spokane, -13; Walla Walla, Rapid City, and Sioux City, -9; Salt Lake City, -2; Kansas City, 4; Wichita and Carson City, 7; Amarillo, 8; Portland, Oreg., 11; Port Angeles, 12; Roseburg, 14; Astoria, 19; Fort Canby, 20; Eureka, 27; Corpus Christi, 30; San Francisco, 38.

The *accumulated monthly departures* from normal temperatures from January 1 to the end of the current month are given in the second column of the following table, and the average departures are given in the third column for comparison with the departures of current conditions of vegetation from the normal condition.

Districts.	Accumulated departures.		Districts.	Accumulated departures.	
	Total.	Average.		Total.	Average.
New England.....	+ 1.7	+ 0.2	Florida Peninsula.....	- 7.8	- 0.7
Middle Atlantic.....	+ 5.9	+ 0.5	North Dakota.....	-16.5	- 1.5
South Atlantic.....	+14.3	+ 1.3	Northern Slope.....	- 6.8	- 0.6
East Gulf.....	+ 5.6	+ 0.5	North Pacific.....	- 4.0	- 0.4
West Gulf.....	+13.0	+ 1.2	Middle Pacific.....	- 1.0	- 0.1
Ohio Valley and Tenn.....	+11.2	+ 1.0			
Lower Lake.....	+ 8.3	+ 1.5			
Upper Lake.....	+16.5	+ 1.5			
Upper Mississippi.....	+12.4	+ 1.1			
Missouri Valley.....	+ 8.0	+ 0.7			
Middle Slope.....	+18.6	+ 1.6			
Abilene (southern Slope).....	+21.5	+ 2.0			
Southern Plateau.....	+ 8.7	+ 0.8			
Middle Plateau.....	+ 1.6	+ 0.1			
Northern Plateau.....	+10.8	+ 1.0			
South Pacific.....	+ 3.2	+ 0.3			

The *greatest daily range of temperature and the data for computing the extreme and mean monthly ranges* are given for each of the regular Weather Bureau stations in Table I. The largest values of the greatest daily ranges were: Helena, 51; Sioux City and Pueblo, 50; Carson City, 49; Rapid City, Miles City, and Amarillo, 48; Moorhead, 47; Dodge City and

Denver, 46; Wichita and Kansas City, 45. The smallest values were: Key West, 13; Jupiter and Fort Canby, 14; Tatoosh Island, 15; Point Reyes Light, 16; San Francisco and Seattle, 17; Hatteras, 18; Astoria, 19; Walla Walla, 20.

Among the *extreme monthly ranges* the largest were: Lander and Pueblo, 98; North Platte, 91; Havre and Idaho Falls, 86; Helena, 85; Denver, 84; Cheyenne and Walla Walla, 80. The smallest values were: Key West, 17; Jupiter, 20; Point Reyes Light, 27; San Francisco, 28; Tatoosh Island, 29.

MOISTURE.

The *quantity of moisture* in the atmosphere at any time may be expressed by the weight of the vapor coexisting with the air contained in a cubic foot of space, or by the tension or pressure of the vapor, or by the temperature of the dew-point. The mean dew-point for each station of the Weather Bureau, as deduced from observations made at 8 a. m. and 8 p. m., daily, is given in Table I.

The *rate of evaporation* from a special surface of water on muslin at any moment determines the temperature of the wet-bulb thermometer; an evaporimeter may be so constructed as to give the *quantity of water evaporated* from a similar surface during any interval of time. Such an evaporimeter, therefore, would sum up or integrate the effects of those influences that determine the temperature as given by the wet bulb; from this quantity the *average humidity of the air* during any given interval of time may be deduced.

Measurements of evaporation within the thermometer shelters are difficult to make so as to be intercomparable at temperatures above and below freezing, and they may be replaced by computations based on the wet-bulb temperatures. The absolute amounts of evaporation from natural surfaces not protected from wind, rain, sunshine, and radiation, are being measured at a few experimental stations and will be discussed in special contributions.

Sensible temperatures.—The sensation of temperature experienced by the human body and ordinarily attributed to the condition of the atmosphere depends not merely on the temperature of the air, but also on its dryness, on the velocity of the wind, and on the suddenness of atmospheric changes, all combined with the physiological condition of the observer. A satisfactory expression for the relation between atmospheric conditions and nervous sensations has not yet been obtained.

PRECIPITATION.

[In inches and hundredths.]

The *distribution of precipitation* for the current month, as determined by reports from about 2,500 stations, is exhibited on Chart III. The numerical details are given in Tables I, II, and III. The total precipitation for the current month was heavy (6 to 11 inches) in Tennessee, Kentucky, and the mountainous parts of Georgia and North Carolina, but heaviest (14 to 27 inches) on the immediate coast of Washington, Oregon, and northern California. It was least, viz, a trace over a large portion of southern Nevada and the adjacent portions of southern California and Arizona. The larger values at regular stations were: Astoria, 16.6; Fort Canby, 15.1; Pysht, 14.5; Portland, Oreg., 13.1; Roseburg, 9.9; Seattle, 9.5. The smaller values were: Yuma, 0.1; Phoenix, 0.6; El Paso, 0.04.

Details as to *excessive precipitation* are given in Tables XII and XIII.

The *years of greatest and least precipitation* for November are given in the REVIEW for November, 1890. The precipitation for the current month was the greatest on record at: Roseburg, 9.91; Marquette, 6.44; St. Paul, 5.07; Spokane, 4.85; Duluth, 3.42; Helena, 3.29; Bismarck, 3.10; Moorhead and Walla Walla, 3.09; Williston, 2.10; Huron, 1.97; Pierre, 1.92;

Concordia, 1.78; Miles City, 1.37; Rapid City, 1.09. It was not the least on record at any regular station of the Weather Bureau.

The *diurnal variation*, as shown by tables of hourly means of the total precipitation, deduced from self-registering gauges kept at the regular stations of the Weather Bureau, is not now tabulated.

The *current departures* from the normal precipitation are given in Table I, which shows that precipitation was in excess throughout the northern half of the country and also in the South Atlantic States, Tennessee, and the Ohio Valley. It was slightly deficient over a narrow belt extending along the middle and the east Atlantic Coast as also from the lower Lake Region southwest to the Rio Grande Valley.

The large excesses were: Portland, Oreg., 7.3; Astoria, 6.8; Fort Canby, 6.6; Roseburg, 6.2; Eureka, 3.9; Marquette, 3.7; Spokane, 3.2. The large deficits were: Shreveport, 3.7; Palestine, 2.8; Corpus Christi, 2.7; Galveston, 2.5.

The *average departure* for each district is given in Table I. By dividing each current precipitation by its respective normal the following corresponding percentages are obtained (precipitation is in excess when the percentage of the normal exceeds 100):

Above the normal: South Atlantic, 114; Florida Peninsula, 127; Ohio Valley and Tennessee, 122; upper Lake, 139; North Dakota, 418; upper Mississippi, 114; Missouri Valley, 119; northern Slope, 230; middle Slope, 123; middle Plateau, 170; northern Plateau, 278; north Pacific, 171; middle Pacific, 158; south Pacific, 128.

Below the normal: New England, 72; middle Atlantic, 84; east Gulf, 92; west Gulf, 45; lower Lake, 75; southern Slope (Abilene), 42; southern Plateau, 56.

The *total accumulated monthly departures* from normal precipitation from January 1 to the end of the current month are given in the second column of the following table; the third column gives the percentage of the current accumulated precipitation relative to its normal value.

Districts.	Accumulated departures.	Accumulated precipitation.	Districts.	Accumulated departures.	Accumulated precipitation.
	Inches.	Per ct.		Inches.	Per ct.
North Dakota.....	+ 3.30	118	New England.....	- 3.60	91
Upper Mississippi.....	+ 1.70	105	Middle Atlantic.....	- 5.10	88
Missouri Valley.....	+ 1.00	103	South Atlantic.....	-11.00	78
Northern Slope.....	+ 1.30	109	Florida Peninsula.....	- 3.90	92
Southern Plateau.....	+ 1.30	117	East Gulf.....	- 7.00	87
Middle Plateau.....	+ 3.50	133	West Gulf.....	-10.30	74
Northern Plateau.....	+ 1.10	108	Ohio Valley and Tenn....	- 2.50	94
North Pacific.....	+ 7.00	114	Lower Lake.....	- 1.10	97
Middle Pacific.....	+ 4.20	117	Upper Lakes.....	- 1.10	97
			Middle Slope.....	- 1.40	94
			Abilene (southern Slope).....	- 3.90	83
			South Pacific.....	- 1.00	90

SNOW.

The total monthly snowfall at each station is given in Table II; its geographical distribution is shown on Chart V. This chart also shows the isotherms of minimum 32° and of minimum 40° for the air within the ordinary thermometer shelter. The former isotherm is an approximate limit to possible snow, while the latter is an approximate southern limit to the regions that report frost on exposed localities.

Snowfalls of from 5 to 15 inches occurred in Maine and New Brunswick; 20 to 30 in Ontario; 15 to 35 near Lake Superior and in the Dakotas; 20 to 100 on the mountains of Colorado; 15 to 50 on those of Montana, Idaho, and California; 20 to 115 on those of Oregon, Washington, and British Columbia.

The *depth of snow on the ground* at the end of the month is given in detail in Table II, and for the winter months is also shown on Chart VI. The condition of the snow on the